A Study of Evaluation of Serum Uric Acid Level in Obesity

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Abstract

Background: Obesity is rapidly increasing worldwide. High serum uric acid has been documented to be associated with obesity. Previous studies have shown a relationship between hyperuricemia and obesity but evidence of such an association in population of Bangladesh is limited. Recent study has been shown that hyperuricemia is a predictor of non-communicable diseases and increase in mortality rate. The aim of this study was to observe the association of serum uric acid with obesity.

Materials and methods: This cross-sectional study was carried out in the Department of Biochemistry in Chittagong Medical College and Outpatient Department of Endocrinology, Chittagong Medical College Hospital. One hundred and fifty (150) subjects ageing (18-55) years were included in this study by non-probability convenient sampling method. One hundred (100) subjects with obesity diagnosed by BMI enrolled as cases and fifty (50) normal weight were enrolled as controls. Important variables in this study were serum uric acid level, Fasting Lipid Profile, Fasting Plasma Glucose, Blood Pressure, BMI and Waist Circumference.

Results: Hyperuricemia was found 45% among cases (χ^2, $p< 0.001$) and 8% in controls. Serum Triglyceride (TG), Total Cholesterol, Increased BMI, waist circumference were positively associated with obesity and Hyperuricemia. There was also positive correlation between serum uric acid with TG, TC, LDL-cholesterol, BMI and waist circumference and negative correlation between serum uric acid with fasting blood glucose and HDL-cholesterol. However this study did not find any significant association between serum uric acid with LDL and HDL cholesterol.

Conclusion: The above mentioned findings suggest that, evaluation of serum uric acid level in obesity may provide data useful for the clinical course of diseases and further relevant research.

Key words: BMI; Hyperuricemia; Obesity; Waist circumference.

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Introduction

Obesity in the last decade become a global problem and has been recognized as a risk factor with a variety of clinical conditions and adverse health consequences, hyperuricemia is one of these conditions.[1] Obesity is steadily increasing worldwide and serious threat for public health and global health care costs, which reduces quality of life, life expectancy and increases morbidity and mortality due to the adverse metabolic effects.[2]

Increased mortality rate in obesity is due to the subsequent development of a wide range of complications that include dyslipidemia, hypertension, atherosclerosis, and type 2 diabetes. These metabolic disorders substantially increase the risk for stroke, angina and myocardial infarction. Non-life threatening conditions linked to obesity include sleep apnea, gallstones, osteoarthritis and gout.[3-7]

Prevalence increases with age and is higher in females ,if secular trends continue, by 2030 an estimated 38% of the world's adult population will be overweight and another 20% will be obese.[8]

A comparative study across developing countries reported that prevalence rate of obesity in adolescents in Asia are highest.[9] Furthermore there are large within and between countries variations across Asia, 3.5% in rural Bangadesh to over 65% in the Maldeves, 30% in Iran and Saudi Arabia and approximately 12.5% for Chinese children.[10]

Obesity is typically defined quite simply as excess body weight for height, but this simple definition belies an etiologically complex phenotype primarily associated with excess adiposity or body fatness, that can manifest metabolically and not just in terms of body size.[11]

The aim of this study was to evaluate the association of serum uric acid level with obesity and to assess the relation with dyslipidemia, hypertension and glucose intolerance.

Materials and methods

This cross sectional observational study was conducted during the period of July 2020 to June 2021 and was carried out in the Department of Biochemistry, Chittagong Medical College and Department of Endocrinology, Chittagong Medical College Hospital. One hundred and fifty (150) subjects aged between (18-55) years were enrollrd by non-probability convenient sampling as per fullfilment of inclusion criteria. Pregnant women, lactating mothers, chronic diseases like-hepatic, renal and cardiac, endocrine disease like-hypothyroidism, cushing's syndrome, subjects who are taking anti-hypertensive and anti-hyperurecemic drugs were excluded.

Permission for this study was taken from the concerned departments and Ethical Review Committee of Chittagong Medical College, Chattogram (Memo No. CMC/PG/2020/668; Date: 22/11/2020). All the patients included in this study was informed and explained properly about the nature and purpose of this study. Data were collected by reseacher herself using a pre-designed structured questionnaire containing all the variable of interest. Measurement of serum uric acid level by autoanalyzer (Dimension EXL 200) in Uricase method.Measurement of fasting serum lipid profile: measured by enzymatic kinetic method using an auto analyzer. Measurement of plasma glucose by enzymatic oxidation in the presence of glucose oxidase.

Statistical analyses were performed using Statistical Package for Social Science (SPSS) for windows version 20.0. Confidence level was fixed at 95% and p values < 0.05 were considered statistically significant. Quantitative data (Fasting plasma glucose, fasting lipid profile, serum uric acid level, age, BMI, waist circumference) were expressed as mean ± SEM and comparison between two groups was done using Students t-test. Qualitative data (Hyperuricemia, Sex and socio-demoghraphic variables) were expressed in frequency and percentage. Chi-squared test or odds ratios were used to measure the significance of association between categorical variables. Correlation analyses between variables were examined by the Spearman's correlation coefficient. Tables bar diagrams and pie charts were drawn in respective presentation when applicable.

Results

Total one hundred and fifty (150) subjects were included in this study, of them one hundred (100) are cases (Group A) and fifty (50) are control (Group B).

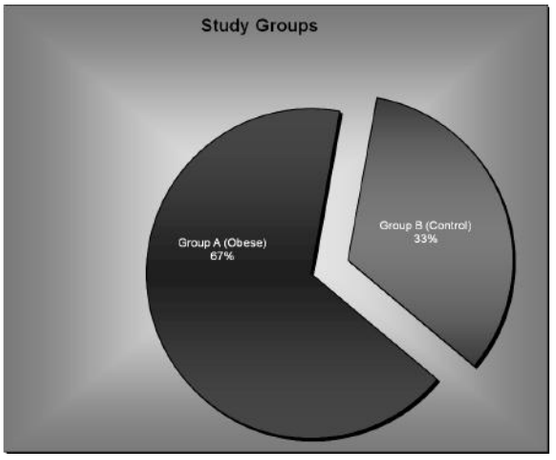

Figure 1 Pie chart showing distribution of the study groups

Table I Distribution of demographic variables among the study groups (With independent samples t-test significance) (n = 150)

Study Groups	n	Mean	± SEM	Range	p Value	
Age (Years)	Group A	100	38.24	0.75	21 –52	p > 0.05
Not Significant	Group B	50	40.32	1.11	25 – 52	
	TOTAL	150	38.93	0.63	21 – 52	
	Study Groups	n	Mean	± SEM	Range	p Value
Systolic Blood						
Pressure (mmHg)	Group A	100	120.30	1.20	100 – 160	p < 0.05
Significant	Group B	50	115.80	1.07	100 – 130	
	TOTAL	150	118.80	0.89	100 – 160	
	Study Groups	n	Mean	± SEM	Range	p Value
Diastolic Blood						
Pressure (mmHg)	Group A	100	82.55	0.88	70 – 100	p < 0.001
Highly Significant	Group B	50	75.20	0.91	60 – 90	
	TOTAL	150	80.10	0.72	60 – 100	

Table shows mean age of cases are 38.24±0.75 years and control are 40.32±1.11 years. Mean systolic blood pressure of cases are 120.30±1.20, whereas control are 115.80±1.07. Mean diastolic blood pressure of cases are 82.55±0.88 but in control group are 75.20±0.91, which is highly significant. (p<0.001) (Table I).

Table II Distribution of anthropometric variables among the study groups (With independent samples t - test significance) (n = 150)

	Study Groups	n	Mean	± SEM	Range	p Value
Body Mass Index (Kg/m^2)	Group A	100	32.69	0.41	26.10 – 47.70	p < 0.001 Highly Significant
	Group B	50	23.05	0.19	20.80 – 25.70	
	TOTAL	150	29.48	0.47	20.80 – 46.70	
	Study Groups	n	Mean	± SEM	Range	p Value
Waist Circumference (cm)	Group A	100	103.15	0.70	90 – 133	p < 0.001 Highly Significant
	Group B	50	81.12	1.00	71 – 94	
	TOTAL	150	95.81	1.02	71 – 133	

Table II shows the mean BMI among cases 32.69±0.41 kg/m^2 and controls are 23.05±0.19 kg/m^2. Mean waist circumference among cases 103.15± 0.70 cm and control 81.12±1.00 cm. Both are statistically highly significant as p<0.001 by t - test significance.

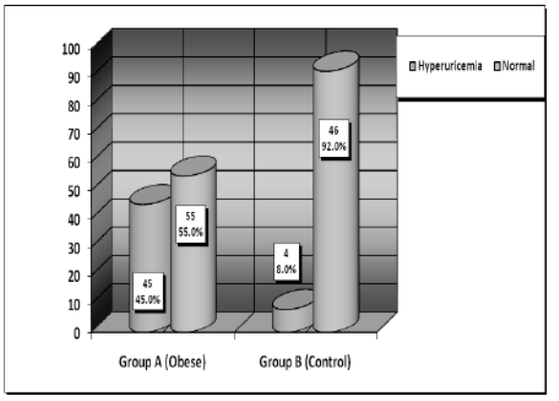

Figure 2 Bar chart showing distribution of serum uric acid status among the study groups

Table III Association between serum uric acid status and the study groups (With Chi-square (χ^2) test significance) (n = 150)

Serum Uric Acid Status	Study Groups Group A (n = 100)	Group B (n = 50)	Total (n = 150)	p Value
Hyperuricemia	45 (45.0)	4 (8.0)	49 (32.7)	p < 0.001 Highly Significant
Normal	55 (55.0)	46 (92.0)	101 (67.3)	

● Figures within parentheses indicate percentages.

Table III was observed that hyperuricemia among cases are 45% (n=100) And statistically highly significant as p<0.001 done by Chi-square (χ^2) test significance

Table IV Association between serum uric acid status and serum lipid profiles among the obese (With Chi-square (χ^2) test significance) (n = 100)

Lipid Profiles		Serum Uric Acid Status Hyperuricemia (n = 45)	Normal (n = 55)	Total (n = 100)	p Value
Serum TC Status	Increased	16 (35.6)	5 (9.1)	21 (21.0)	p < 0.01 Highly Significant
	Normal	29 (64.4)	50 (90.9)	79 (79.0)	
Serum TG Status	Increased	36 (80.0)	29 (52.7)	65 (65.0)	p < 0.01 Highly Significant
	Normal	9 (20.0)	26 (47.3)	35 (35.0)	
Serum LDL Status	Increased	21 (46.7)	15 (27.3)	36 (36.0)	p < 0.05 Significant
	Normal	24 (53.3)	40 (72.7)	64 (64.0)	
Serum HDL Status	Decreased	36 (80.0)	41 (74.5)	77 (77.0)	p > 0.05 Not Significant
	Normal	9 (20.0)	14 (25.5)	23 (23.0)	

● Figures within parentheses indicate percentages.

Table IV shows that increased serum total cholesterol was more associated with cases (35.6%, n=16) than that of controls (9.1%, n=5) which is statistically highly significant by Chi-square (χ^2) test significance as p<0.01.

Discussion

According to Asian Pacific cut off points, BMI is categorized into four (4) groups [12]:

- Underweight : < 18.5 Kg/m^2
- Normal Weight : 18.5 – 22.9 Kg/m^2
- Overweight : 23.0 – 24.9 Kg/m^2
- Obese : ≥ 25 Kg/m^2

In adults, serum uric acid levels are positively correlated with BMI and hyperuricemia is considered to be a common lifestyle disorder related with obesity.

Some studies have demonstrated that increased uric acid levels can lead to increment of BMI by other mechanisms. Chen et al declared hyperuricemia may be associated with fat accumulation by different mechanisms such as:

- Inhibition of Adenosine Monophosphate (AMP)- activated protein kinase
- Increasing uric acid – dependant intracellular and mitochondrial oxidative stress
- Activating the nuclear transcription factor, carbohydrate responsive element binding protein and increased ketohexokinase expression.[13]

In addition, it could be due to overproduction and poor renal excretion of uric acid also address that

elevated serum uric acid in obesity, including elevation of uric acid, can be due to impairment in urinary urate excretion[14-15].

Li et al demonstrated that the prevalence of overweight-obesity, hypercholesteremia, hyper-LDL-cholesterol, hypertriglyceridemia, hyperglycemia and insulin resistance increases with elevation of serum uric acid level.[16]

Emerging evidence shows that hyperuricemia is prevalent not only in the developed countries but also increasing in the low and middle-income countries with a high frequency.[17] Thus, hyperuricemia is considered to be a common lifestyle disorder related to obesity in humans.[18]

Moreover, it has been recognized as an associated risk factor with a variety of adverse health consequences including diabetes, hypertension and elevated SUA.[19] Hyperuricemia and its relation with obesity have been documented in previous studies.[20] A significant positive association has been found between SUA and obesity in the adult population.[21]

In the present study, we explored the prevalence of hyperuricemia and the potential association of serum uric acid with obesity.

Complete clinical profile, Anthropometric data with serum samples were recorded for comparison of Serum uric acid level between cases and controls. It was found that Hyperuricemia was more among the cases (45%) than controls (8%).

Mean age is not significantly higher in cases than that of controls (38.24 ± 0.75 Vs 40.32 ± 1.11) which was not similar to other studies, but mean systolic blood pressure and diastolic blood pressure (120.30 ± 1.20 Vs 115.80 ± 1.07), (82.55 ± 0.88 Vs 75.20 ± 0.91) significant in cases than that of controls as $p<0.05$. The findings were similar to other research works done by Honggang WANG, Lizhen WANG et al.[22]

Highly significant positive correlation was also found between serum uric acid and waist circumference, as $p<0.01$. Although a positive correlation between serum uric acid and BMI were found, statistically not so significant as $p>0.05$, which was similar with another previous research works by authors,Wang et al.[22]

In more recent studies, a significant positive relationship was observed between serum uric acid levels and obesity in population of China, Japan, India, Pakistan, Iraq and United States.[23, 24]

Consistent with our findings several epidemiological studies have also shown a positive association of serum uric acid with overweight and obesity in different population. For example, In a 10 year follow-up study, BMI was found to be significantly inreased with increasing serum uric acid levels in all race-sex groups.[25]

The results of the present study, showed that, increased serum total cholesterol was more associated with cases (35.6%,n=16) than that of controls (9.1%, n=5) which is statistically highly significant by Chi-square (χ^2) test significance as $p<0.01$.

In this study, the bivariate correlation between serum uric acid and total cholesterol, triglyceride, LDL cholesterol and HDL cholesterol was done. It revealed that, total cholesterol, triglyceride and LDL cholesterol had a significant positive correlation with uric acid. Whereas High density lipoprotein had inverse correlation with uric acid.

Although a positive association between obesity and serum uric acid levels has been reported in previous studies; the mechanism by which how uric acid is inreased in obesity has not well elucidated yet.

Limmitation

The present study had certain limitations. The purposive method of sampling and relatively small size can be mentioned as examples. Besides, cross-sectional study is observational and casuality cannot be inferred.

Conclusion

The study revealed a significant association between obesity and hyperuricemia. These findings suggest that obesity results in a multiplicative increase in the risk of hyperuricemia. It is clearly indicated that Body Mass Index (BMI) is associated and positively correlated with circulating urate concentrations. Obese people show hyperuricemia, which is associated with metabolic syndrome in obesity and as such, uric acid synthesis increased and uric acid exretion from the kidney decreased. Therefore routine measurement of Serum Uric Acid level (SUA) is recommended in obese individuals to prevent hyperuricemia and its related complications.

Recommendation

i) Further studies are required to establish an association between obesity and serum uric acid level.
ii) The sample size could be increased substantially so that a generalized conclusion could be made among the Bangladeshi population.
iii) Community based interventions should be aimed to convey awareness to follow a healthy lifestyle, promote healthy food alternatives and increase in physical activity.

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Contribution of authors

MTA- Conception, design, acquisition of data, manuscript writing and final approval.
MH- Interpretition of data, critical revision and final approval.
SA- Analysis, interpretition of data, manuscript writing and final approval.
SMZK- Design, critical revision and final approval.
HH- Acquisition of data, critical revision and final approval.
PA- Acquisition of data, critical revision and final approval.
MHI- Design, critical revision and final approval.

Disclosure

All the authors declared no conflict of interest.

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